

What does the Mid-Atlantic Ridge do to the mean state of the North Atlantic Ocean and climate?

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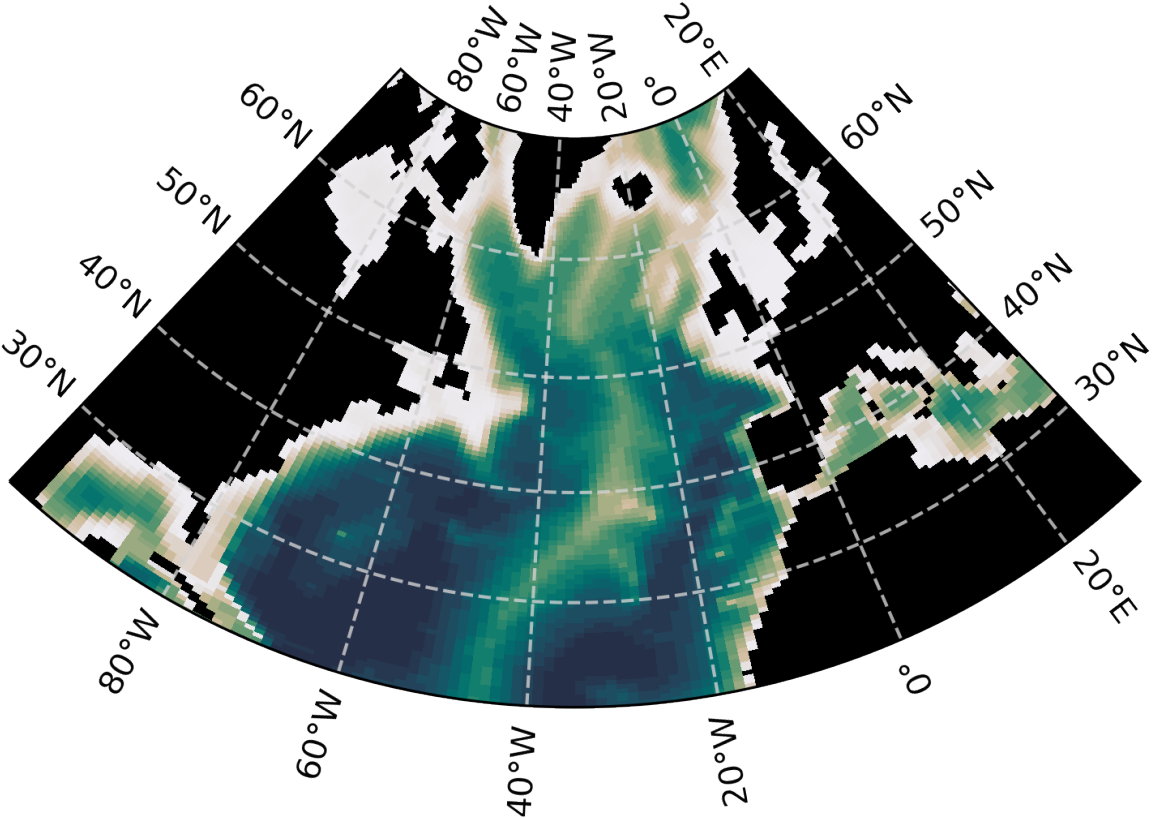
How does the presence of the Mid-Atlantic Ridge in the North Atlantic affect:

- the gyres
- the AMOC
- SSS, SST, and SLP

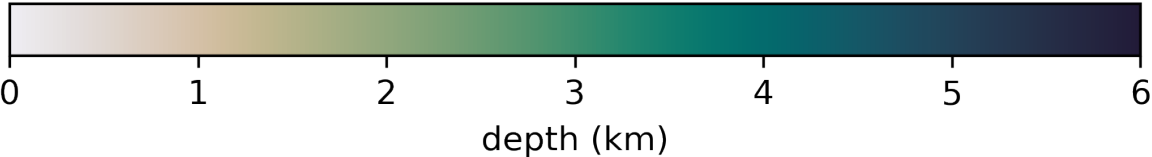
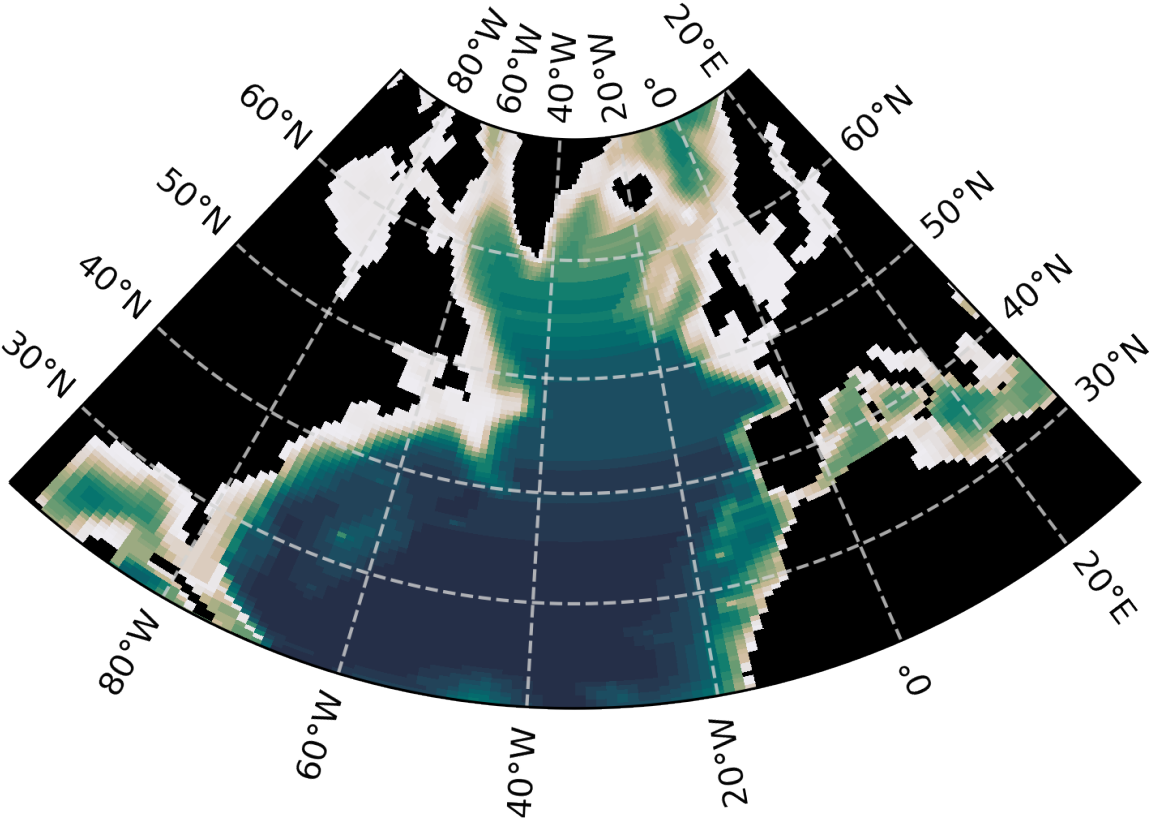
The MAR is removed in CESM2 by filtering the lowest zonal wavenumbers in KMT from 20°N to Iceland between abyssal basin minima.

CESM2 is integrated for 100 years, and the last 50 years are used for averaging.

CESM2 default



Flatlantic

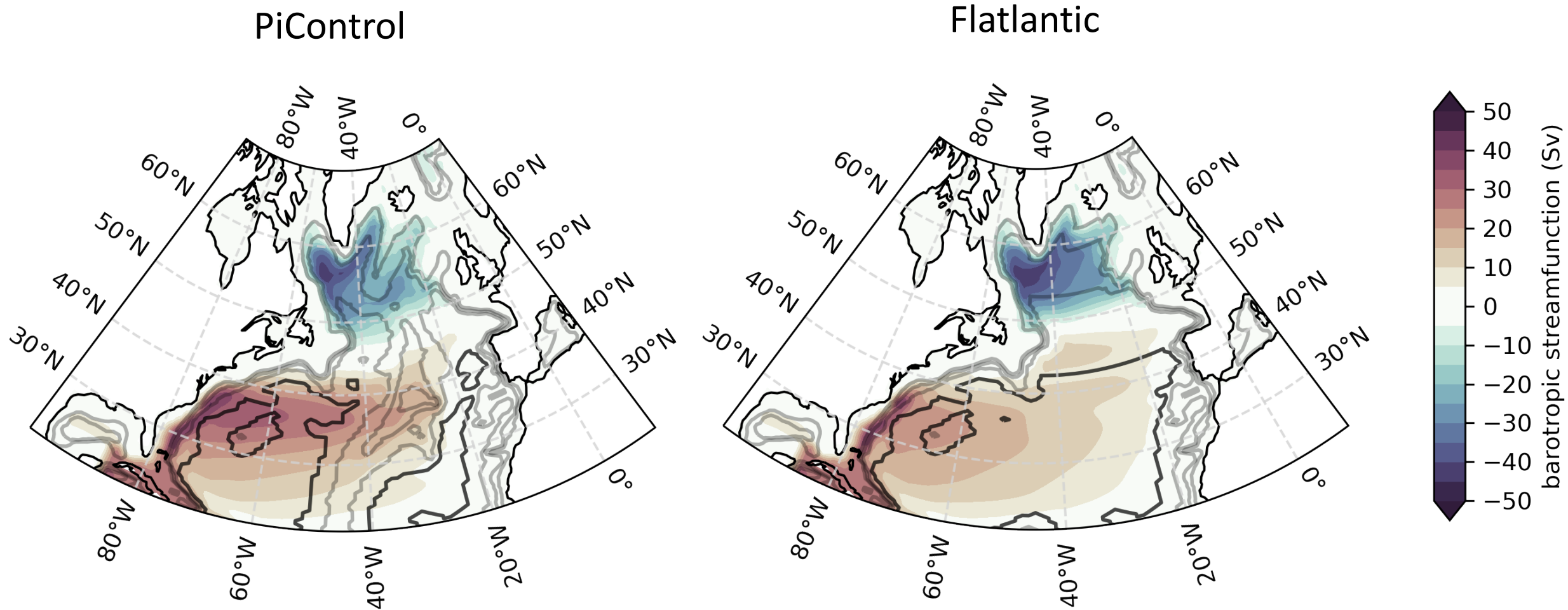


Thank you to Nan Rosenbloom for advice on the Paleoclimate Toolkit and to Mike Levy and Keith Lindsay for debugging help!

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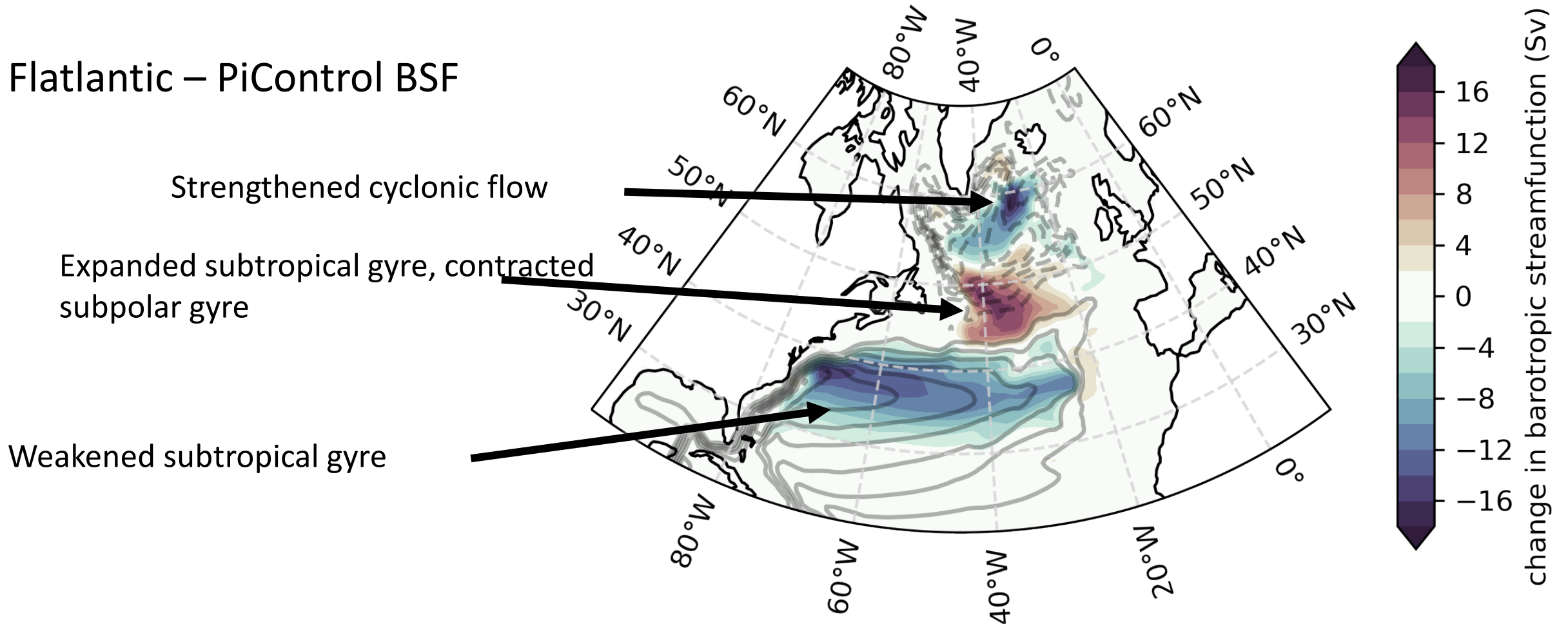
Flatlantic response:
Subtropical gyre weakens and expands northward.
Subpolar gyre strengthens over missing Reykjanes Ridge.



Barotropic Streamfunction (shading); Isobaths (contours) from 2-5 km (gray) with 5 km emphasized (black)

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Flatlantic – PiControl BSF

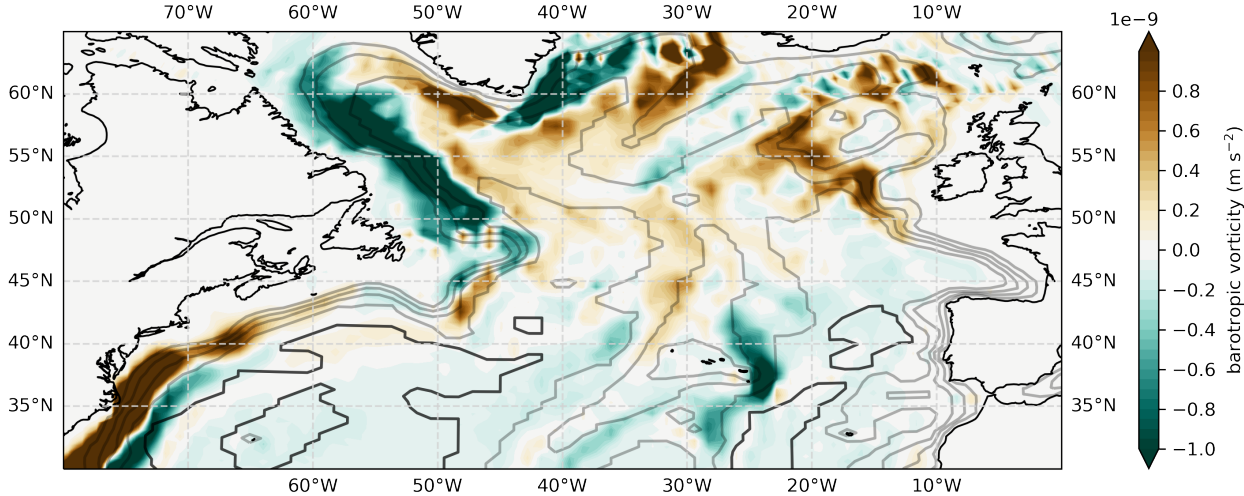


Flatlantic minus PiControl Barotropic Streamfunction (shading); CESM PiControl BSF (contours every 5 Sv, solid pos, dashed neg)

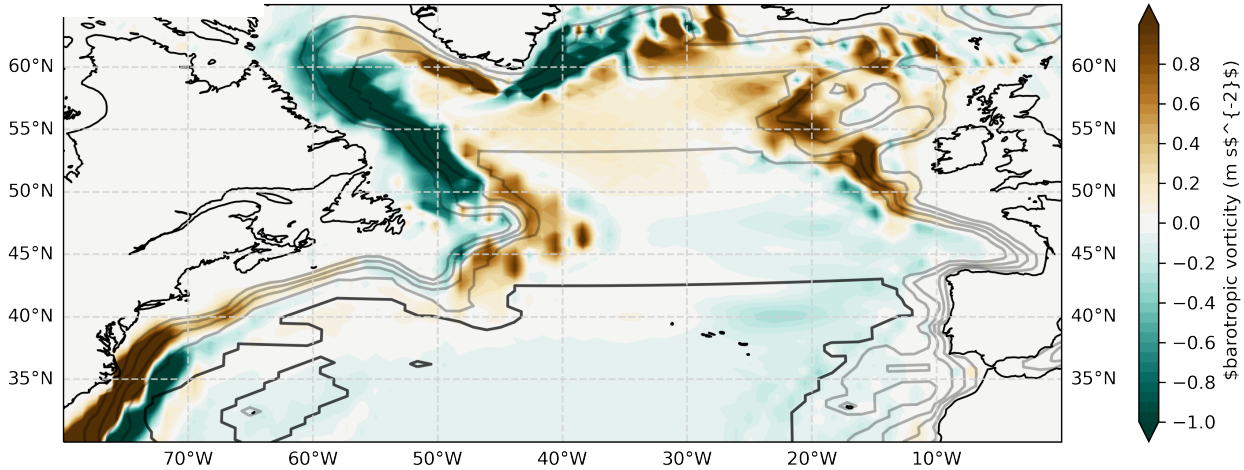
Meridional adjustment of βV over the MAR and on western boundary

PiControl

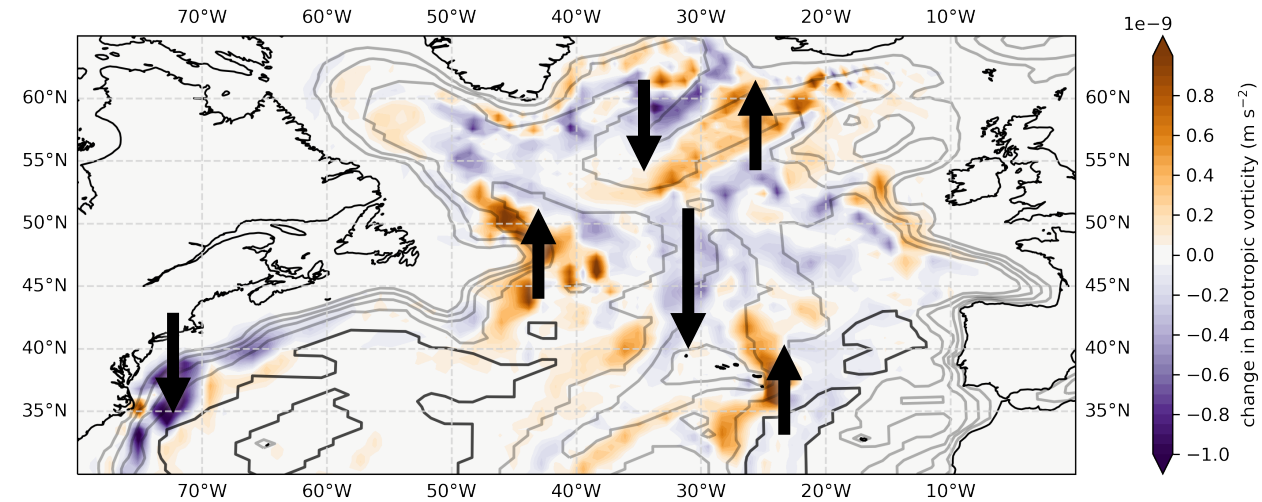
planetary vorticity advection



Flatlantic



Flatlantic minus PiControl



Change in full-depth βV (shading); Topography (contours)

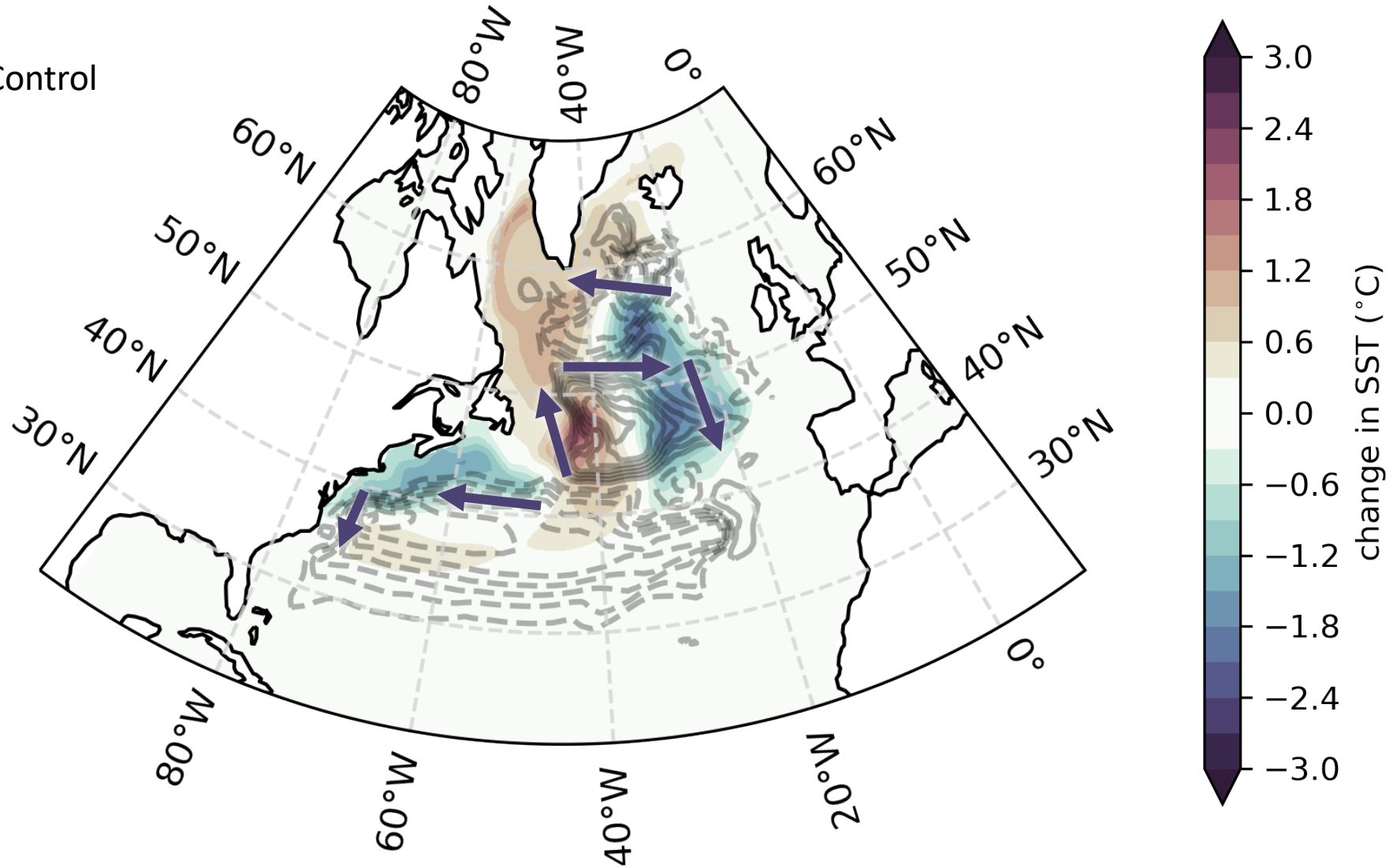
Full-depth βV (shading); Topography (contours)

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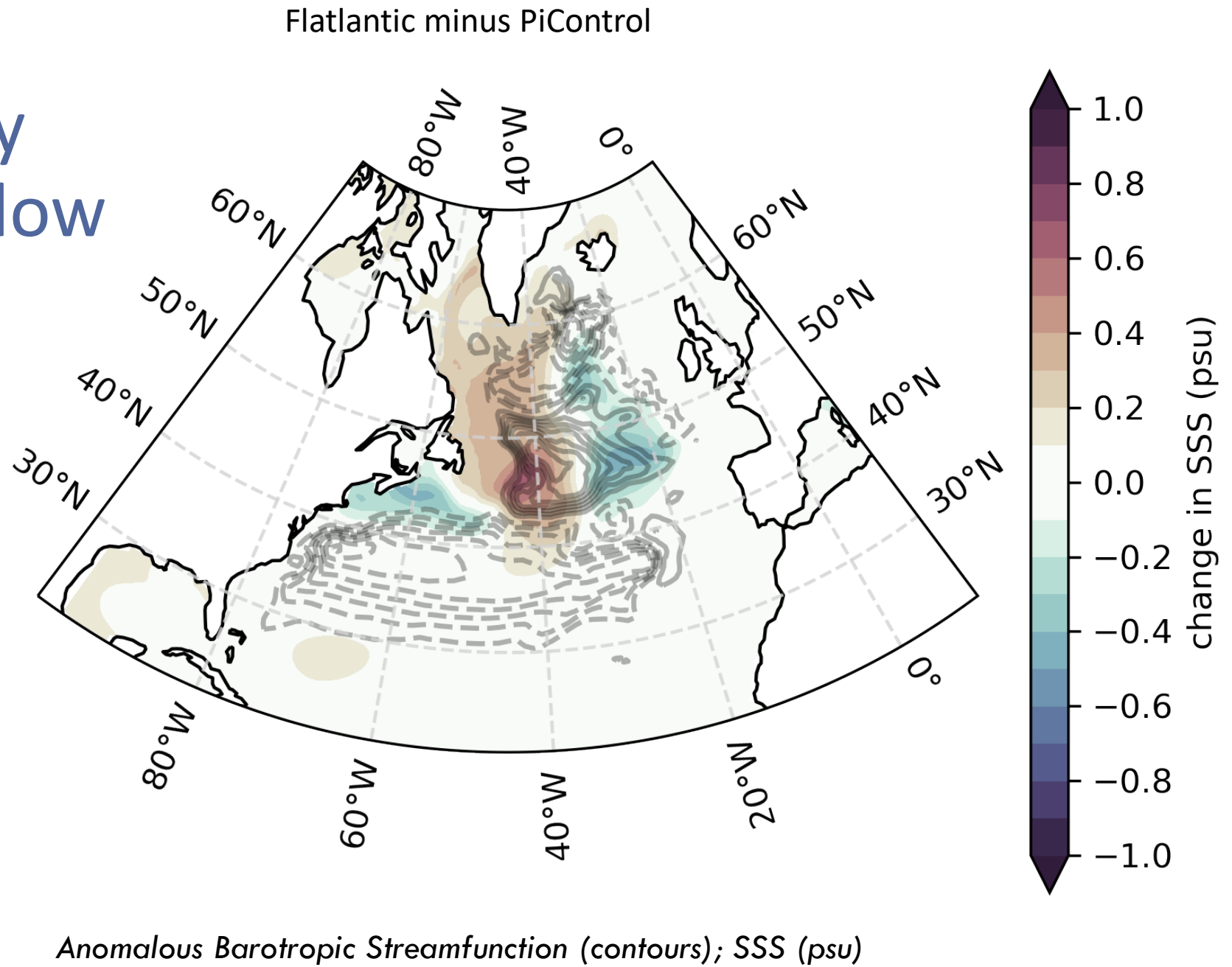
SST in Flatlantic adjusts following new gyre circulation

Flatlantic minus PiControl

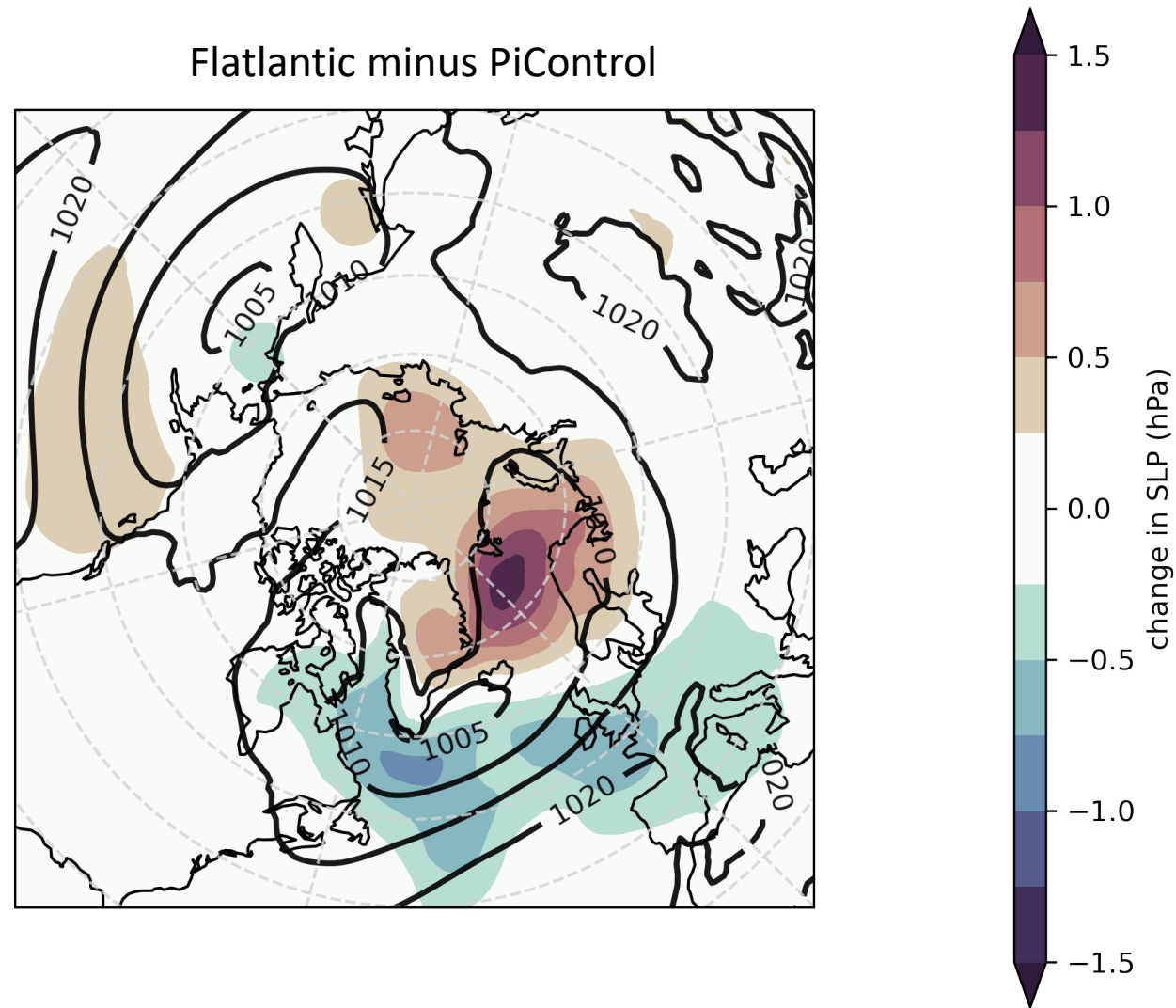


Change in Barotropic Streamfunction (contours); Change in SST (shading)

Sea surface salinity anomalies also follow Flatlantic gyre advection



Icelandic Low shifts southward slightly

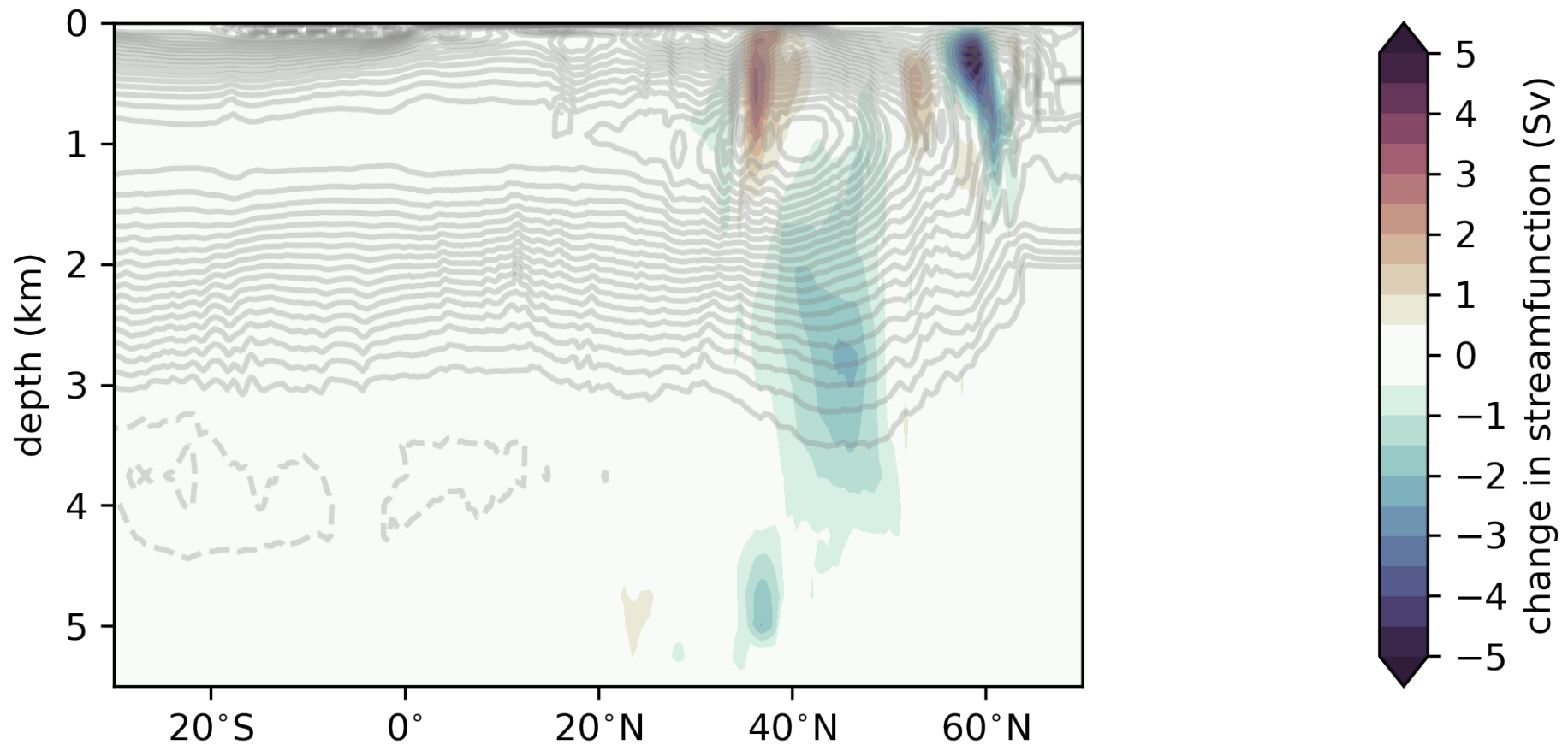


PiControl SLP (contours every 5 hPa); Flatlantic minus PiControl SLP (shading)

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AMOC: local adjustment of a few surface currents and weakened deep interior pathway



PiControl AMOC (contours every 1 Sv, solid pos, dashed neg); Flatlantic minus PiControl (shading)

Summary

Removing the Mid-Atlantic Ridge in CESM:

- Weakens but expands the northern part of the subtropical gyre
- Strengthens the northern part of subpolar gyre that contracted on the southern side
- Causes SST and SSS anomalies up to $\sim 1.5^{\circ}\text{C}$ and 0.3 psu in the North Atlantic
- Shifts the Icelandic low slightly southward
- Weakens the AMOC deep interior pathway along the MAR by ~ 2 Sv

